Fraser River Estuary
Management Program

Third Annual
Fraser River Estuary Workshop
on
Monitoring and Research

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Province of British Columbia

PROCEEDINGS

THIRD ANNUAL FRASER RIVER ESTUARY WORKSHOP ON MONITORING AND RESEARCH

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Fraser River Estuary Water Quality Plan

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ABSTRACT

The Standing Committee on the Fraser River Estuary Water Quality Plan, as part of its activities under the Fraser River Estuary Management Program, held its third annual workshop on February 21 and 22, 1989. The purpose of the workshop was to review new environmental information and foster communication between scientists actively working in the estuary, resident industry, government agencies and environmental interest groups. More than 70 individuals registered for this year's workshop.

The first day focused on scientific investigations currently under way in the Fraser River and on Sturgeon and Roberts Banks. A special session in Boundary Bay was held in the morning of the second day. Representatives from the U.S. and Canada presented papers addressing scientific studies and the benefits of compatible/comparable studies to better define transboundary pollution issues. Papers presented on the final afternoon reviewed various Action Plans being developed for the FREMP study area.

ACKNOWLEDGEMENTS

The Standing Committee wishes to thank all the speakers and workshop attendees for their participation. A special thanks goes to Dr. G. Vigers for suggesting, helping to organize and chairing the Special Session in Boundary Bay and Northern Puget Sound.

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1. INTRODUCTION

The Fraser River Estuary supports many activities which may compete for use of the aquatic environment. The salmon runs on the Fraser River are among the largest in the world, with major commercial catches of all five Pacific species, important native food fisheries, and a significant sports fishery. The Fraser Delta is also a major resting and feeding area for migratory birds on the Pacific flyway. The Fraser River Estuary and Delta support the many forms of aquatic life at lower trophic levels which fish, birds, and other wildlife utilize as food. The Estuary is also used extensively for recreation, including boating, hunting, bird-watching, hiking and swimming.

The Fraser River Estuary is a zone of intense urban and industrial activity resulting in many influences on the aquatic ecosystem. Industrial effluents and landfill leachates are discharged either directly to the river or indirectly through municipal outfalls. The lower Fraser River and Sturgeon Bank receive municipal wastewater which has undergone primary treatment. In addition, the Estuary receives stormwater and combined sewer overflows (periodic discharges of mixed, untreated sewage and stormwater). The river is dredged frequently and is a major transportation corridor. Log booms are transported and stored along the shores. Several sawmills, lumber dipping and storage operations and pulp and paper mills are located along the shoreline. The water of the Fraser River is also used by industry as process and cooling water. Additionally, intensive agricultural activities require water for irrigation and product runoff containing pesticides and fertilizers which enter the river. The lower Fraser River is not used as a domestic water supply because supplies of higher quality exist in the Coast Region watersheds to the north.

The many resource based activities which occur along the Fraser today require that the water quality of the river be maintained or improved. The Fraser River Estuary Study (FRES) and the Fraser River Estuary Management Program (FREMP) were both initiated to address these and resolve conflicting activities and ensure maintenance of the aquatic environment. The study area boundaries for FREMP are shown in Figure 1.

Through FREMP a Standing Committee on the Fraser River Estuary Water Quality Plan has been formed, with three provincial and three federal representatives, and one representative from the Greater Vancouver Regional District. The purpose of the committee is to develop a plan which will include ambient Water Quality Objectives for the study area, a coordinated monitoring program and documentation of an acceptable arrangement for enforcement. The overall purpose for the plan is to maintain and, where possible, improve the environmental quality of the Estuary.

The duties of the Standing Committee also include providing advice on water quality matters, providing a Status Report on Water Quality at regular intervals and advising on procedures for public input and public information.

The annual Workshop on Monitoring and Research is one way the Standing Committee can obtain information on recent environmental studies to use in development and update of the Water Quality Plan and Status Report. It also functions as a forum to foster communication between scientists actively working in the estuary, resident industry, government agencies at all levels and environmental interest groups.

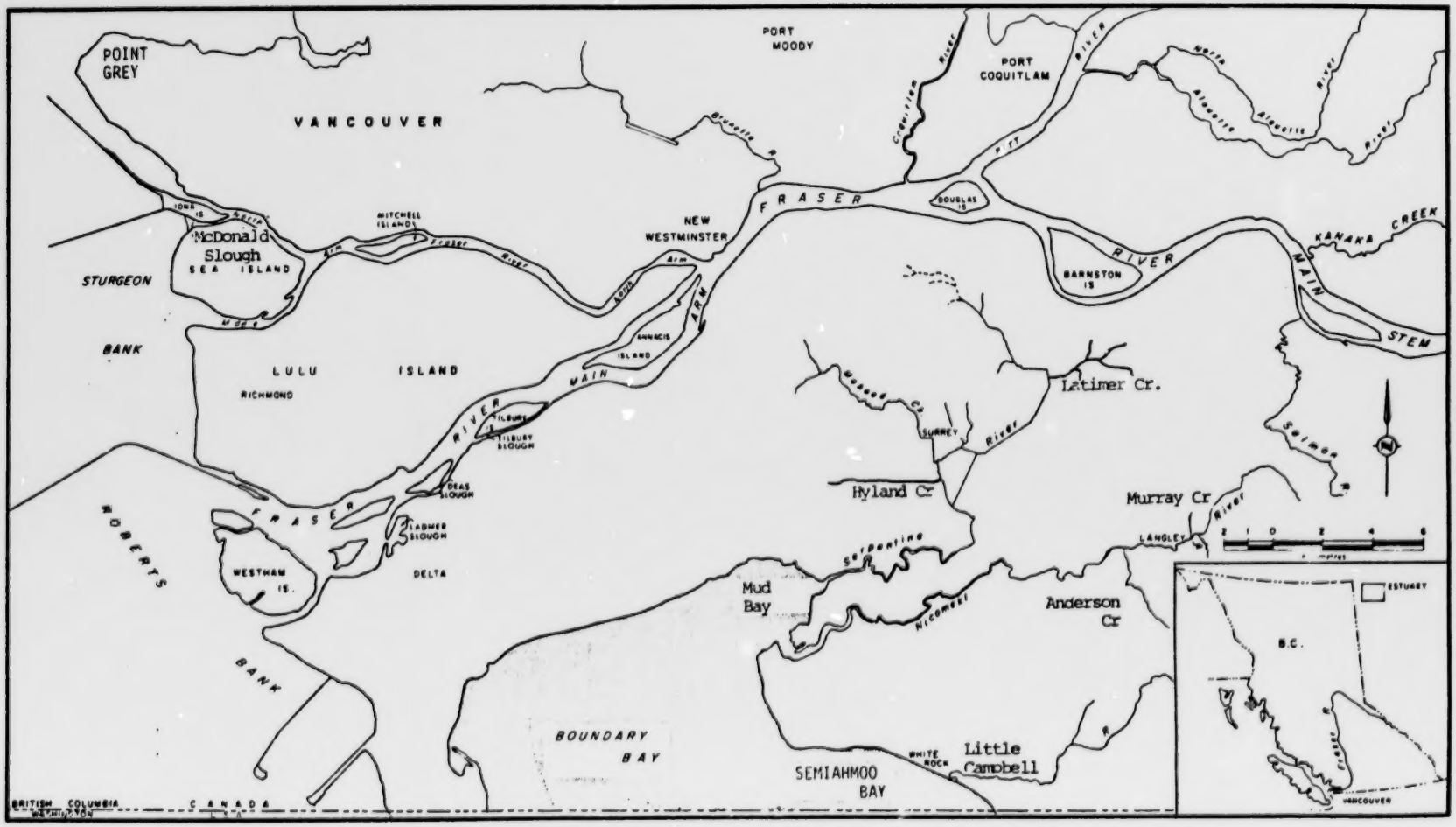

FIGURE 1 : THE FRASER RIVER ESTUARY

2.0. ABSTRACTS, QUESTIONS AND ANSWERS

2.1. GENERAL SESSION

2.1.1. SALT AND FRESH WATER EXCHANGE ON ROBERTS BANK, BRITISH COLUMBIA

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One of the aspects of the seaward movement of fresh water from the Fraser River is its passage tangential to Roberts Bank and subsequent recirculation onto the bank. A synoptic study of the oceanography of the bank is described, part of a larger study of surface currents in the Strait of Georgia. Seasonal changes in salinity and temperature over Roberts Bank are presented. The freshwater flows and motions of the salt wedges in the river and on the bank are described. Under the restraints of a retaining wall immediately north of the river, and on the incoming tide, a shallow layer of fresh water briefly forms an eddy, varying in size with river discharge and extending over the bank to the south. The influence of the two-layer flow on sedimentation is also discussed.

Questions and Answers:

Q. Are those numerical models applicable to actually determining the currents on Roberts Bank or do you need to use actual data? Can you apply it right on the Bank?

A. The model GF8 sees the Bank in 2 km pieces, which I don't think fully resolves it. We will get general agreement with the currents on the Bank. We always need measurements to calibrate. We could take half the data for calibration and half for verification. Such fluctuations as the rising of the isopicnodes will show up. The formation of fronts won't, as the area that is involved is only 2 - 4 km and it won't resolve that. The model was developed in collaboration with the University of Hamburg, who are doing

considerable amounts of research on their models, a continental shelf model and also high resolution estuarine models. The Elbe Estuary model has, I believe, a 250 m resolution model, the Elbe is about 2 km wide. That type of model has sufficient resolution to see a lot more. The type of model we have now can sort of see the things on the Bank, but for a really detailed calculation we would need models with better resolution such as the University of Hamburg model. The model that I am working on is almost identical to the University of Hamburg model, so potentially it can show further detail of the Fraser River Estuary.

Q. Would your model of the Strait of Georgia be able to resolve and define the deposition of sediments transported in the Estuary?

A. Not now, but when I am finished, and when the model is properly calibrated, provided one knows the physics of whatever is being deposited. Other parameters are involved such as a salinity calculation, vertical and horizontal component; however, that is one of the ways in which we hope to use the model.

Q. Have you combined the tidal model data with observations and looked at it with criteria such as the Simpson criteria? I wondered about the grid size on the GF8 model. What is the internal rosby radius of deformation during freshet period? I would be interested in more details about the model.

A. The Simpson-Hunter parameter is not relevant, as it deals with density. The front criteria is more along the lines of the size of a pressure gradient on the Bank as the tide is rising versus the pressure gradient in the river itself. We could look at the size of the pressure gradient, we have not done that yet. As for the rosby radius, I don't know it, I could estimate it. The model has a 2 km horizontal mesh resolution. The vertical layers are in differing depths. I am currently using GF6 which has levels of 5, 15, 30, 50, 100, 150, 200 increasing layer thickness as you go down. The model is a semi-implicit, reasonably standard three-dimensional model.

A. The traditional Simpson-Hunter parameter is not appropriate in this situation. A recent paper presents H/UQ and shows the parameter that matters is H/U. We noted while working on the St. Lawrence Esturary that H/UQ did not work well. The internal rosby radius of deformation is smaller than maybe 2 km.

2.1.2. PREDICTED WATER LEVELS IN THE LOWER FRASER RIVER, RESULTING FROM A RISE IN THE MEAN SEA LEVEL

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Some researchers are forecasting that a rise in mean sea-level will occur due to the 'greenhouse effect'. Estimates of contributions from factors such as the thermal expansion of sea water and the transfer of snow and ice from land to sea suggest rises of from 38 cm. to 212 cm. by the year 2075.

The impact of such changes upon the water levels in the Fraser River are studied using a previously developed numerical model. Two scenarios simulate the recorded extreme conditions of the highest tides at Point Atkinson, and, separately, the highest river discharge at Hope. Maximum predicted water levels for the extreme tide indicate a 1.0 ratio of increased level to sea-level rise for all but the furthest upstream reaches. In the second scenario, the extreme discharge has a damping effect, with a ratio of 0.5 at New Westminster, decreasing to 0.1 at Mission.

Questions And Answers:

Q. You mentioned two storm surges, one in 1948 and one in 1982. I am not familiar with the 1948 case.

A. It was not a storm surge. In 1948 it was a case of high discharge, although there were two consecutive high tides in 1948.

Q. Is there any historical data on sea level changes in the area?

A. I am sure there is. It is very hard to quantify the amount of sea level rise historically because it is such a long term thing. On my estimates of sea level rise there was a current trend ignoring the green house effect. By 2050 ad we have a 10.5 cm increase based on historical records.

Q. Is this sea level rise actually occurring now?

A. I don't feel i am qualified to say. There is a lot of differing opinions. It would be very gradual, hard to measure, there are local factors involved. I am looking at what might happen to the fraser river if this occurs.

Q. By 2100 the rate of change is still increasing. Is this likely to plateau in time, say 500 years? The year 2100 is certainly not the worst case.

A. This was as far as peple were willing to forecast. These estimates are based on our emissions of carbon dioxide. We have only really been burning fossil fuels this century, to any great extent, since the major industrialization occurred. Even if we stopped now, it would take about 30 years for current emissions to reach equilibrium as far as global warming is concerned. The thermal expansion of the oceans would have to react to that global warming. So the rate is accelerating because of our industrialization and increased emission of these gases.

2.1.3. GROUNDWATER QUALITY FROM AGRICULTURAL PLOTS IN THE LOWER FRASER VALLEY

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Fertilizer nitrogen (N) leaching through subsurface drains and pesticide concentration in soil and groundwater (at the water table level) were monitored in four agricultural plots, located in Delta, north of the Boundary Bay airport. The soil at the plots was classified as a humic luvic gleysol of the Ladner series, and supported stands of silage corn, potatoes, hay, and strawberry crops. Three (A, B, and C) of the four plots were drained with drainlines located at about 1.1 m below the soil surface at all times, except during brief periods of heavy rainstorms. On the contrary, free water at the surface was a common occurrence in the undrained plot during wet periods.

(NO3 + NO2) N constituted 54 to 95% of the total N measured in the drainwater. The (NO3 + NO2) N concentration peaked during winter months of high subsurface flow. The maximum concentration of 12 mg/L was recorded during the 2-year monitoring period. About 17 to 48% of the applied N was lost through the drainlines.

The presence of atrazina, vernolata, dinoseb, metribuzin, and EPTC was evident in soil as a result of herbicide treatment. The dinoseb content in strawberry plots was probably the result of a previous year application. Traces of herbicides were also found in some groundwater samples. How real the contamination of groundwater with pesticides was, could not be assessed because of limited data.

Questions And Answers:

Q. How would you explain the higher levels of nitrates in the drains as opposed to the ground water?

A. All the flow was acting toward the drains and not just to the instrument strip at groundwater. The groundwater was not at all contaminated by the fertilizer applied. The drains collected all the water from the fields, plots which were treated with fertilizer Nitrogen and those areas not treated.

Q. You mentioned fertilizers, herbicides and other pesticides, but isn't one of the main sources of contamination from farms from feedlots. How does that compare to fertilizer application?

A. There are lots of examples in the literature related to feedlots, or application of manures, such as in Langley-Abbotsford and the mis-management of poultry manure. However, I cannot compare the two. As far as I know, this is the only information we have in the Fraser Valley, aside from some work done in Agassiz.

Q. Is that 200 kg/ha applied standard practice, or is that heavy loading to get an idea of results over time.

A. The nitrogen applied was at a rate recommended by the B.C. Ministry of Agriculture, it could be higher. The application rates recommended are probably derived for average soil and crop conditions. In some cases, having organic debris left over on the soil can produce a lot of nitrogen. The amounts of nitrogen released by nitrification or mineralization of organic material were considered when fertilizer application rates were decided.

Q. Were you concerned with salt water intrusion and salt levels in the soil?

A. No, we were not looking at that.

Q. I was concerned about the characteristics of the soil you were dealing with. It is fairly organic in that area, and poorly drained. When you looked at the data, were there any problems with pesticides? How applicable would your results be to an area like Abbotsford where you have more sand and gravel in the soil?

A. With respect to pesticides, we have not taken enough samples. There are some evidences, but a year later there was nothing. Certainly it is a more organic soil than in other areas of the valley, and we would expect the pesticides wouldn't move through.

Q. Are you planning more studies up the valley? What about initial studies where you use a laboratory study on absorption and desorption on different soil profiles.

A. Funding is always a problem. The Provincial government does not put a lot of emphasis on lab studies. We can monitor things.

Q. Recently we have heard of the build-up of heavy metals in agricultural soils. Did you look at heavy metals from the fertilizer applications in your study?

A. No we did not, but certainly that is an area we should look at.

2.1.4. A SURVEY OF METAL VALUES IN FISH FROM THE FRASER RIVER ESTUARY

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Fish were collected from one site in each of the Main Stem, North Arm, and Main Arm of the Fraser River during August 1988. These sites had been selected since sediments and benthic organisms had been collected at the same sites in 1987, and fish had been collected at the Main and North Arm sites in surveys during 1980 and 1972/1973.

Muscle and as possible, liver samples were collected from the fish specimens and analyzed for metals, chlorophenols, PCBs, phthalate esters, PAHs and organochlorine pesticides. Only data for metals can be compared to concentrations found in the earlier surveys. Most of these other characteristics were previously tested only in limited numbers.

Three fish species, northern sqavfish, peamouth chub, and large scale sucker were collected in all three surveys. Concentrations of most metals from the 1988 survey when compared to the 1980 survey were approximately the same while they were similar or lower than found in the 1972/1973 survey.

Questions And Answers:

Q. Why were those particular species first chosen? I understand why you would perpetuate their use. What quality control measures were used in the analyses? How comparable is the data from the three studies? Were standards and reference material compatable? Could the reduced mercury levels be reflecting better quality control and better standards?

A. Initially the contractor was probably told to do X effort. We targeted five species and ended up taking what we could get. These were initially probably the easiest species to catch. Out of all the sample effort expended in 1988, only two salmon fingerlings were caught. The lab quality control program was from ASL labs. The usual spikes, dupes and blanks were run. We don't knov yet if they did a good job. We will have to wait until we can vork with all the data.

Q. Were the fish populations localized enough to be indicators for specific regions?

A. If the values are identical from reach to reach, the concern is valid. If values are different reach to reach, residency is indicated. The results have shown some differences from reach to reach.

Q. Was the sampling pre- or post-freshet?

A. The 1988 sampling was done in August, post-freshet. The peak of contaminant build-up in sediment would be in February. However the initial program in 1985 was in February, and there was no success in fish collection, so we chose August. Singleton's work was done in July - August so it should be comparable. We are not sure about Northcote's work.

Q. For bottom fish like starry flounder, February would be a better time to sample. Were your analyses done on white muscle tissue?

A. Yes. On larger species the livers were separated for analysis.

Q. Do you have any criteria for human consumption and the state of health of the fish?

A. We haven't had time to prepare anything like that yet. We don't anticipate any health concern.

2.1.5. ESTABLISHMENT OF SEDIMENT QUALITY OBJECTIVES

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A method is proposed to establish sediment quality objectives above the baseline level and below the effects threshold, in other words, in the "grey area" where effects may or not occur. This method uses a safety factor based on the bioaccumulation potential. The following formulae are derived:

$$SQO = MAX + (ET - MAX)F \qquad \text{(Equation 1)}$$

$$SQO = MAX + \frac{(ET - MAX)}{BF} \qquad \text{(Equation 2)}$$

$$SQO = MAX + \frac{(ET - MAX)}{\log BCF} \qquad \text{(Equation 3)}$$

$$\log BCF = \log Kow - 1.32 \qquad \text{(Equation 4)}$$

$$SQO = \frac{ET}{\log Kow - 1.32} \qquad \text{(Equation 5)}$$

Examples are given for trace metals and PCB's with reference to Apparent Effects Thresholds developed for Puget Sound, Washington, U.S.A. (PTI Environmental Services, 1987). Using AET data from Puget Sound, Equation 5 would set a generic sediment quality objective for PCB's at 26 ng/g using Equation 5 where:

ET= 130 ng/g, the lowest Apparent Effects Threshold from Microtex tests of Puget Sound sediment,
logK - 6.34, which is the mean of octanol-water partition coefficients for Aroclors 1016, 1248, 1254 and 1260, as given by Mackay (1982).

A complete description of the procedure is available.

REFERENCES PTI Environmental Service 1987. Policy Implications of Effects-Based Marine Sediment Criteria. For US EPA, Washington, D.C.

Mackay, D. 1982. Correlation of bioconcentration factors. Environ. Sci. Technol. 16:274-278

No questions.

2.1.6. FOREST INDUSTRY LOG HANDLING AND STORAGE ON THE FRASER RIVER

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Initially the coastal forest industry encompassed most of the lower mainland using the nearby forest stand to supply mills along the river. Competing land uses displaced much of the industry and today, the Lower Fraser is the processing focus of a major portion of the British Columbia coastal forest industry.

Log storage in the Fraser River Estuary is an important link with other log handling activities occurring in proximity to the river. This summary report explains these linkages and attempts to place the river activities in context with the activities occurring in other areas.

Currently, there are 40 operations located in the Fraser River Estuary. These operations consume 25% of coastal timber production, employ 9,400 people at an annual payroll of over $260 million, and generate a sales value of final products of approximately $650 million (1984) of which 55% is exported to foreign markets.

In order to maintain consistent production, an efficient and constant delivery of raw logs to each operation is required. The vast majority of this inventory is imported to the river from coastal areas by barge or boom. Booms are either bundled (80%) of flat rafted (20%). The majority of logs are delivered to the river by boom.

River storage needs are related to the full coastal logging and operating season and must account for variations in consistency of delivery due to freshet, logging camp closures due to fire, and adverse weather conditions. In addition to maintaining a base inventory of about 1 1/2 months supply, river storage is also required for several purposes other than meeting direct consumption needs. Logs destined for other locations are brought in for protection against marine borers as no other alternatives are available. Some logs are found to be unsuitable for processing and held in the river until they are sold or traded. The log trading and brokerage firms also use the

river for storage until their logs are sold. All of these factors add up to a large overall demand for log storage in the Fraser River Estuary that is, in aggregate, fairly consistent year round. The volume of logs flowing through the area is 25% greater than the volume consumed by the converting plants in the area.

Questions And Answers:

Q. Do you have any regulations on how you can dump logs into the water so less debris and bark fall off them?

A. I don't believe so. We have to apply for a log storage lease, and when you apply for that lease it goes through a referral system to various agencies. At that point, before you are provided with a log storage lease, certain restrictions can be attached to the lease.

2.1.7. AN UPDATE ON TOXIC CHEMICAL ACCUMULATION IN AQUATIC VASCULAR PLANTS OF THE FRASER RIVER ESTUARY

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AIM Ecological Consultants Ltd. initiated a study in the fall of 1987 to examine the levels of specific contaminants in the Fraser estuary, in the water column, in the sediments, and in various plant species. This research was funded by Supply and Services Canada and Environment Canada.

In September 1987, February 1988 and July 1988 water, sediment and plant samples were collected at 4 sites across the Fraser estuary, selected to reflect a variety of environmental conditions. The chemical analyses were carried out by Analytical Service Laboratories Ltd. (ASL) of Vancouver. A separate component of the study involved determining the effects of high levels of contaminants on "clean" plant material using greenhouse grown marsh species. Hydroponically grown plants were analysed to determine background contaminant levels and the rate of contaminant uptake. The objectives of the study were to determine if toxic materials are being stored in various plant species; whether or not the plants are concentrating the chemicals and to what levels.

Results of the field sampling have revealed considerable variation across the estuary. The highest levels of cadmium in sediments were collected from Musqueam Marsh in September (0.43 ug/g). However, on average, Woodward Island had the highest sediment cadmium levels of the stations sampled (0.27 - 0.34 ug/g). The opposite was true for copper, lead and zinc. The sediment levels of lead sampled at Musqueam Marsh (max 39.3 ug/g) were almost two times that of the other sampling locations. Woodward Island had the lowest levels

sampled. Mercury results were highly variable between sampling dates, but for any given sampling date, Woodward Island had the lowest levels of mercury in the sediment. The highest levels of organic contaminants in sediments were also detected in Musqueam Marsh (0.01 ug/g) with one notable exception, that of high TCP levels detected on the Richmond foreshore (0.04 ug/g). In contrast, the lowest levels of PCB's detected were from the Richmond foreshore. Contaminant levels in the water sampled were well within acceptable concentrations, and in some cases were below detection limits. No relationship was determined between the contaminant concentrations in plants or sediments and the water samples collected.

Vegetation analysis showed that there were significant differences in the chemical accumulation between species. Of the 4 species sampled, Carex lyngbyei, Scirpus validus, Scripus americanus and Scripus maritimus, the latter two showed very similar patterns of chemical accumulation which was also similar to, but lesser than the Scirpus validus. The sedge (Carex lyngbyei) showed significantly greater accumulation of metals an organic contaminants, than did the rushes (Scirpus spp). There were highly significant differences detected between the plant components within species. The concentration of chemical was consistently greater in the root systems than in the shoots. There was much greater variablility within the roots than the shoots, possibly due to adhering sediment particles, and possibly due to variations in chemical concentrations with depth.

Seasonal variability in the concentration of chemicals within the plants to a large extent reflects their annual cycles. High levels of cadmium, mercury and PCB which were detected in the root systems in the fall may indicate the culmination of a season's growth and collection of contaminants within the plant. Changes in the concentration of some chemicals over the winter may reflect leaching to the sediments. Hydroponic studies and transplant experiments indicated that there may be a more rapid response to changing environmental conditions than we had expected at first.

Those contaminants which were being accumulated in the vegetation to levels above that found in the sediments included cadmium (maximum 4x sediment concentration), mercury (maximum 1.2x sediment concentration) and PCB (maximum 11.9x sediment concentration). These results were to a large extent corroborated by the hydroponic experiments, although in the hydroponic studies mercury was accumulated to 2.5x sediment levels. The other chemicals were found in the plant shoots at up to 20% of sediment concentrations for Cu and Zn, and 8% for lead. In plant roots the concetrations were, Cu- up to 100%, Zn up to 40% and Pb up to 22%. For PCP and TCP, the balance between roots and shoots was more even than for metals and the average concentrations ranged between 40 and 80% of sediment levels.

Questions And Answers:

Q. What is the significance of your findings to birds and animals?

A. The vascular plants are used to a great degree. The roots of both sedge and rush are consumed by snow geese in particular. Other waterfowl eat seeds in the late summer and early fall, and also feed on the detritus. Invertebrates feed on detritus, so they can take up contaminants the plants are concentrating and pass them on through the food web to fish or birds.

Q. Are there any concurrent studies on other organisms?

A. Sean Boyd, who is in the audience is doing studies on the snow geese. We chose one of our sampling sites to match with his study area, so we can try to combine the results of the two studies.

Q. Do we know anything yet as to what are critical levels for the snow geese, or other animals?

A. There are not any that I know of.

Q. The bar graph shown of your data, is that the average of a number of samples of plant material?

A. It depends on the individual graph. The information was summarized as well as we could. Some were averages. There were replicates at each site, usually the replicates were very close to each other. Where there was uniformity from one station to another over the entire estuary, we pooled the results in some cases to get a broader range. For a large part, n = 2.

Q. Are similar studies being done internationally? How do they compare?

A. I am still trying to dig out information. There have been very few studies similar to this. There has been a fair amount of work done on Spartina on the U.S. eastern seaboard. I'm trying to compare the results. The Spartina, like the Carex, does concentrate chemicals, some to very high levels. Mercury for example, is concentrated by Spartina even more than by Carex.

Q. One of the objectives of this study is to look at plants as a bioassay tool for heavy metal contamination. Why did you not pick the Sturgeon Bank area, which is highly contaminated? I know you had a Richmond station, but why not close to the Iona outfall where you know you have significant trace metal levels, to see how they transfer to the plants?

A. We thought about it. We tried to match our sites to those of C.W.S., to try to get their results comparable to ours. The Richmond and Reifel sites were chosen in conjunction with C.W.S. Musqueam was chosen as a contaminated site, and Woodward was chosen as a pristine site.

Q. Do any of the sample areas have extensive hunting? Would lead pellets from shotguns add to lead contaminations?

A. The Richmond foreshore had a lot of hunting previously. I believe it is now closed.

C. There are two major hunting seasons for snow geese, one in the fall and one in the spring. Hunting goes all the way to March 10 for snow geese, it stops January 28 for ducks and other geese. There are a lot of hunters at Brunswick Point, which is a major hunting area. At the Reifel Sanctuary and the Alatsin National Foreshore Area hunting is not allowed. There are a lot of hunters around those areas, not so many any more in Richmond, where they have prohibited shooting toward the dyke, so there are not many hunters around Sea Island. There is a lot of lead shot going into the estuary. In a preliminary survey a couple of years ago, based on a hunter questionnaire, they came up with a rough estimate of a couple of tons of lead that goes into the estuary each year. It is fairly well scattered, and heavy so it sinks into the mud, but the geese and swans may actually accumulate it as they grub for roots and rhizomes.

Q. Is anyone doing a similar study on non-vascular plants?

A. Not that I am aware of.

2.1.8. CHINOOK RESIDENCY STUDIES IN THE FRASER

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Juvenile Chinook using the lower Fraser originate from the three life history types currently recognized for B.C. chinook: ocean type, "90 d type", and stream type. Hatchery reared chinook are also beginning to use the lower river extensively. Mainstem habitats and side channel habitats above Chilliwack are used extensively by all three forms. Aggasiz appears to be the lower boundary for extensive overwintering by stream type fish. Many habitats are used by the ocean type chinook originating from the Harrison River, including riverine and estuarine marshes, riparian habitat, sloughs and side channels, and sand flats on Sturgeon and Roberts Bank. This form is also known to use the mouths of tributary streams (eg Brunette River). Because of difficulties of stock identification for the "90 d" fish, data are poor on the distribution and habitat use of this life history type. These larger fish (> 80 mm usually) may not be available to beach seining and their abundance may have been underestimated in work to date. An intensive surface trawling programme covering nearshore and mid-channel habitats was conducted September 1987 to September 1988. Resulting data should help improve our knowledge of

this form. Effects of changed water improve our knowledge of this form. Effects of changed water quality on chinook cannot be assessed without detailed knowledge on this species' juvenile ecology and resulting adult production.

No questions.

2.1.9. HABITAT USE OF THE FRASER DELTA BY LESSER SNOW GEESE

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Lesser Snow Geese from Wrangel Island, Soviet Union, winter on the Fraser and Skagit deltas. Their pattern of use of the 2 deltas is consistent from year to year. On the Fraser, the geese arrive in early October, build to peak numbers by mid-November, and then decline to zero or very few by mid-January. That decline coincides with an equal but opposite increase on the Skagit. A large proportion of the geese return to the Fraser by mid-February, peaking by mid-March. They gradually leave until none remain by late April. Plots of numbers versus time suggest little interchange between the Fraser and Skagit at any time of the year. The pattern of use of the 2 deltas is intriguing since they are only about 100 km apart. A difference in some environmental factor (eg. type or amount of a preferred farm crop, temperature or storm wave conditions) is suspected as the driving force behind that pattern. Based on air photo counts, the number of goose-days and the peak number of geese on the Fraser increased by about 4.2 and 3.7 times, respectively, from 1974/75 to 1987/88 (ie. from 760,000 to 3,160,000 and from 10,000 to 37,000, respectively). Numbers are very sensitive to fluctuations in the production of young on the nesting grounds (from zero to 50%).

The geese have only recently started field-feeding on the Fraser system. That may be a result of a reduced carrying capacity of the forshore marsh or changes in land-use practices adjacent to the marsh (Alaksan National Wildlife Area and surrounding farms). I am in the process of determining goose impact on the marsh, marsh regeneration capability, and carrying capacity through the use of exclosures in the preferred zone of feeding (Scirpus americanus) inside and outside the boundaries of a major refuge. A major part of the study involves the refining of a non-destructive sampling technique to predict above- and below-ground plant biomass.

No questions.

2.1.10. SEDIMENT METAL LEVELS ON ROBERTS AND STURGEON BANKS

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In February 1988 sediment samples were collected at low tide, using the Canadian Coast Guard hovercraft, from 11 stations. Duplicates were submitted for particle size, sediment volatile residue, and trace metal analyses. Trace metal concentrations were determined by ICAP using a reverse aqua regia digest. Corresponding triplicate samples were analysed for PCBs via electron capture gas chromatography. Chlorophenols were similarly determined (after conversion to anisole derivatives). Objectives of the sampling program were to determine spatial variability of contaminants, and to relate present concentrations to levels previously obtained by Environmental Protection in 1985-86 (Harding et al. 1987) and those of Grieve and Fletcher 1976.

Fine grained sediments (% silt and clay) and sediment volatile residue (SVR) data followed similar patterns: both were elevated near Woodward Is. (MA-2), near the Musqueam Marsh (NA-1), Sturgeon Bank Marsh (WI-3) and near Iona sewage outfall (SB-I). Chlorophenols (PCP & 236-TCP) were highest at NA-1 and SB-1 (1.3, 0.9 ng/g). PCB-1260 was only detected at NA-1 (0.89 ug/9), while traces (0.02 ug/g) of PCB-1248 were detected at NA-1, I-1, SB-1, WI-3, and MA-2. Mercury, zinc and copper followed the general pattern of % silt-clay and SVR. These metals were significantly correlated with SVR ($r>0.57; p<0.01$) and with each other ($r>0.8; p<0.001$). Only mercury was not significantly correlated with % silt and clay ($r=0.36$). Lead was elevated at two stations on Sturgeon Bank (WI-3, SB-1) and was not correlated to either SVR or % silt-clay, although it was correlated to all other metals except nickel and chromium. Nickel and chromium exhibited similar distribution patterns ($r=0.84$; $p<0.001$): both were elevated above benthic AET levels (Tetra Tech 1986) at stations on the boundary of Sturgeon and Roberts Bank (28, RB-1). These two metals were generally not correlated with other factors measured, except iron ($r=0.67$; $p<0.001$). Iron was also above the benthic AET at stations 28 and WI-1.

Trend analysis is not complete, however the question of normalizing to 100% recovery of certified sediment standards was raised as a means of controlling inter-year lab variability.

References: Grieve, D.A. and W.K. Fletcher. 1976 Can. J. Earth Sci.13. 1383-1693.
Harding et al. 1987. EP Regional Program Report PR 87-18. West Van.
Tetra Tech Inc. 1986. USEPA Reg. 10. & Wash. State Dept. Ecol. Seattle.

Questions And Answers:

C. How do you feel about normalizing to 100%, or do we just report these standard yardsticks and say this year was 75%? How do we relate that to other people's data, who have similar standards? It is not a significant feature when looking at data variability within one years' sampling, but when you look at the data from several years it can be a potential problem. It depends on the element you are looking at and the standard matrix you are dealing with. So what do we do?

Q. Is your data all from grab surface samples? Did you do any vertical analyses from cores?

A. We only did surface samples, no cores. What do you think about normalizing?

Q. With all the work going on, on the Fraser, I would like to see a concensus of how that work is reported.

C. When reporting data it is not good enough to say I used "Standard Methods". You have to give exact details of what you did, the standard you used, how you treated the data. If someone else has something comparable, he can attempt to make the data comparable to his.

2.2. SPECIAL SESSION - BOUNDARY BAY AND NORTHERN PUGET SOUND

2.2.1. INTRODUCTION TO SPECIAL SESSION- BOUNDARY BAY AND NORTHERN PUGET SOUND

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Good morning and welcome to the special session. Today we have an excellent group of speakers who will talk about current activities in Boundary Bay, including three speakers from Washington state who will describe their parallel activities in Northern Puget Sound. After the speaker presentations, I look forward to some active discussions on transboundary issues, and perhaps raise or address questions such as:

- Why are we monitoring and what should we be monitoring in these areas?
- Should monitoring objectives be tied to specific remedial actions?
- Should we be looking at opportunities for rehabilitation and restoration?
- What compatible multiple-use approaches are possible in the utilization of these marine resource areas?

Boundary Bay is a somewhat unique marine resource in British Columbia that has been included in the FREMP because of proximity, rather than estuarine characteristics. The Bay is flushed by rich productive waters that move in a clock-wise gyre from the Straits of Juan de Fuca through the Fraser River discharge plume into Boundary Bay, and then south and east through Semiahmoo Bay on the American side of the International Boundary. Boundary Bay represents approximately 12,000 ha. of intertidal habitat, and is the largest single intertidal marine area in British Columbia. Biophysically, the area is more characteristic of Northern Puget Sound than the rocky intertidal fjord-like characteristics of British Columbia waters. For the past decade, Boundary Bay and the areas south to Bellingham have been ignored in environmental monitoring programs by Federal, State, or Provincial agencies.

Boundary Bay supports a rich habitat for fish, invertebrates, and waterfowl. Ducks Unlimited have established the Serpentine marsh as a bird sanctuary, which supports literally tens of thousands of birds. All flows into Boundary Bay are regulated. The Bay is dyked to protect upland farms and dairy lands from saltwater intrusions, and a series of five pump stations located on the northern and western perimeter of the Bay drain the upland agricultural areas. In addition there are two natural drainages - the Nicomekl and the Serpentine Rivers which enter the Bay at the eastern end, both of which have gates and are flow - regulated.

From 1912 until 1962, the area supported major commercial shellfish harvesting activities, particularly oyster culture, which was terminated by a shellfish closure because of fecal coliform contamination, originating from domestic and rural sources. This closure, under Secion J of the Fisheries Act, has never been rescinded. The last monitoring in the Bay occurred in 1976, when the Environmental Protection Service undertook a sanitary shellfish survey following the completion of a major sanitary sewer interception program to collect all domestic sewer wastes for treatment at Annacis Island.

At about the same time, the City of Blaine completed installation of secondary treatment. The Drayton Harbor area adjacent to Blaine has been re-certified as an unconditionally approved shellfish growing area. However, evidence of agricultural and domestic pollution is still obvious on both sides of the border.

With this setting as a background, I look forward to hearing from our speakers about current research and monitoring activities in these areas.

Questions And Answers:

Waldichuk: You said you were planning a joint program, what parameters are you going to look at?

A. We had in 1985, conducted a study in Boundary Bay which looked at water quality, sediment quality and biota. We were looking at metals, PCP's that had come down the creek from a paint spill at that time and trying to map it in the Harbour. We were also looking at bacteriological studies and what concentrations were in the sediments and the water. We were going to do intertidal studies. In biota we were looking at trawls for macrofauna, and at infauna as well to look at population structures. We had approximately 15 - 20 stations on the Canadian side of Boundary Bay waters, and on the U.S. side.

Waldichuk: Did you do tissue analysis?

A. From the fish we were analysing muscle tissue for metals and we were looking at the liver for organic contaminants. There is a report available, 1986, The Environmental Conditions in Boundary Bay.

Samis: We earlier talked about storm water and C.S.O. controls by the year 2000. I am especially concerned with this in Vancouver Harbour. In a heavy storm event, raw sewage overflows. We already have problems with fish and contaminated sediments. How realistic is it to assume we can handle stormwater and the associated problems? You mentioned some communities are already on separate sewers. Is that move going to continue or should we backtrack and run it through a secondary plant?

Copping: We don't have the answers. In the last 5 - 10 years the move has been to separate. We are now starting to have some serious concerns. The Authority and the E.P.A., I think, are now not pushing separation, we're pushing treatment even if very simplistic, at the source. It is as yet undecided if it is necessary to try to force the communities toward further treatment of the storm water. The first CSO separation was done by the Municipality of Metropolitan Seattle who manages sewers and discharges in the area. It is not looking like it is going to be a big success because of the receiving water that it's going into. We are pushing for a solution, at least in the Action Plan by the year 2000. Whether or not those plans will all be implemented is a good question.

Armstrong: We are encouraging public education to get people to use things in moderation, and not to dump it down the sewer. Kids especially pick it up.

Waldichuk: I think it is vital to have some information, over a period of time on the inputs to Boundary Bay. We heard about pump stations draining agricultural areas. Nothing at all is being done on the Nicomekl River, the Little Campbell, and the Serpentine. These have been responsible for fish kills within the streams. They have been responsible for high coliform counts in the Bay. We need to know something about these sources, for over a period of at least a full year to start with.

Walton: There has been a lot of work done by our office. The people involved unfortunately could not attend today.

Vigers: I would like to take a stance. I think Boundary Bay should be open for commercial aquaculture production. That should raise a lot of other questions, such as, what should those resources be used for? What should be the purposes of a monitoring program? We have people from Conservation here and we have people from Fisheries here. What problems do they have? Do they see any merit in having a monitoring program on the Nicomekl or the Serpentine? How does it serve their particular vested interests?

Langer: Monitoring sounds great. We can spend millions of dollars on monitoring and it will tell us what the trends are. It will confirm that fish cannot live without oxygen on the lower Serpentine. We know there are problems there. I wouldn't put a high priority on getting out there to do more monitoring and collect more data unless there is legislation and a will in place to get after the problems on the system. Right now that will does not exist.

You take conventional farming practices, which I would say are highly unconventional, when farmers are dumping double the recommended rates of pesticide and fertilizer on their fields. We have 800 pigs on 4 acre farms. Tom mentioned we can get after these quite easily, but I would have to disagree. We have officers out there today legally investigating a pig farmer who spreads all his manure two days before the rain comes and today we know its all in the local salmon streams, probably killing fish again. There is no one in the provincial mechanism who is really addressing that problem. You talk about the dairy farmers getting together and peer pressure getting after the farmer down the road who is dumping his effluent in the stream and is making the industry look bad. That is totally inadequate. Until the authorities have a proper mandate to get after these problems and are willing to do so, monitoring is not going to help anything except better inform us what the problem is. When we can get after the problem, then we can use the monitoring data, but let's not monitor until we have that next big step.

Vigers: What type of effort is required in the monitoring area to support initiating those legislative changes?

Langer: We would have to get into labor intensive and quite costly inventories. I don't think anyone really knows how many pig farmers we have out in Langley, Surrey and these areas, that are dumping into these river systems.

This goes for dairy farms also. How many of them are applying proper practices? In terms of monitoring, there's a lot of basic inventory work to be done. How many animals are we trying to put on an acre of land? Are there guidelines in place? If they are over that limit, what other treatment practices must they go to? Maybe they will have to put their effluent into sewer systems and direct it to the proper domestic sewage treatment plant, instead of just dumping in on the field and letting it wash away in the next storm.

You also need long-range monitoring-trend stations right in the river system, looking at basic, simple things like dissolved oxygen.

We are having great problems with D.O. every time we have long sunny periods in the fall we have kills of coho salmon. We need that type of monitoring right through to long term monitoring and sediment chemistry, and right on out into Bounday Bay in terms of uptake.

Armstrong: Do your press or environmental/naturalist groups raise these issues so that people are aware of them?

Langer: They have been raised so often over the last many years, I think the press are at times tired of covering them. A fish kill is not big news anymore. A lot of the environmental groups are, I think, as disorganized as the Government at times. There are so many issues, and they get paid less than us government types to pursue them. There is a lack of coordination on their behalf, just as there is in Government. It is a matter of the Government showing more leadership and will, and then getting the public on their side and directing the focus to getting after some of these problems.

We have a long-term goal to open Boundary Bay.

Armstrong: You have painted a bleak picture. Will that change?

Langer: You just have to look at the trend indicators. It is not turning around. Thirty-five thousand people have moved to B.C. in the past year, and almost 80% moved to the Lower Mainland. The biggest percentage moved into Surrey. Look at the sedimentation caused by the massive land clearings from the almost 30,000 housing developments just in the Lower Mainland. A lot of those are on the Serpentine/Nicomekl watersheds. Many of those are on septic tank. I can't be optimistic in terms of maintaining some of these systems just for salmon production, from a physical habitat point of view. Look at the hydrologic changes to watershed in terms of runoff. How can you be positive unless you are really serious about protecting the environment and getting strong covenants to keep people away from streams, keep cattle away from streams. I don't think that is going to happen in 1989.

Bettison: A number of people have mentioned public groups and their role in monitoring. I would like to mention a number of aspects in the sense of services that our groups can provide. I think you are getting a number of well-educated people who are temporarily unemployed but want to keep their skills up, to get involved with public groups because we have the contacts at the Government level and at the professional level. We can draw this information out. We can get these people to participate in public meetings. Our own group is about 90% advisors from the universities and the Federal and Provincial governments, and about 10% citizens. We can find out what is needed to be done and bring this to the attention of the municipal governments because we have access to our municipal representatives, and to the Federal and Provincial levels. It provides an extra avenue of getting this information across. In Boundary Bay we have already been able to make the municipality aware of programs that have been initiated at the Federal and Provincial level. I think we have been instrumental in bringing about some contact between Federal, Provincial and Municipal staff. We are also able, by drawing on people who are retired and able to work at a volunteer level, to produce mapping of Bounday Bay's environmentally sensitive areas and the recreational use of these. It is a preliminary map, but it gives people some idea of where they need to do some further studies. We are hoping through this to get a 4-level planning system in place, which would be Federal, Provincial, Regional and Municipal. In addition we are doing a public information program, and hopefully will move into the schools as well. We are doing a video tape for cable television. If I were charging for my services to the municipality it would be quite expensive. Instead they are getting it free, as are the government agencies. Public groups can act as coordinators if they are well organized and can draw on retired or temporarily retired people in the community. Once we get going on the planning and mapping we are hoping to attack some of the pollution problems in Boundary Bay, that is our next focus.

Waldichuk: O. Langer said all you are going to get from more monitoring is to be better informed as to where the pollution is coming from. Fish kills are quite common-place, so what are we going to gain. I think this is exactly what we want, we want to be better informed, to be able to pin the violators down as the causes for some of these pollution problems and salmon kills. For example, Fisheries Officers are inspecting another fish kill. They look at the pig farmer who has 100 pigs on a small piece of land. They say you are causing the fish kill, the low dissolved oxygen is due to the organic matter being discharged. The pig farmer accuses the paint manufacturer upstream of dumping paint thinner in the stream. Without that kind of information what can the officers do?

Langer: You are never going to be able to afford a monitoring program that can say he was dumping paint yesterday, and he is dumping pig manure tomorrow or the next day. That's a multimillion dollar program. The type of monitoring program we can afford isn't going to give us the kind of information you just outlined, that the officer needs.

Copping: When the Authority first started out, one of their chief focuses was the non-point pollution issue. Our chief opponents were the agricultural community. They were after us in anything we tried to do. In a few cases our enforcement agencies tried to go after a few farmers and levy very punitive fines. It really did not get us very far. Once we realized where the opposition was, we formed a committee strictly of agricultural interests; cattle men, dairy men, and nursery men. It was very labor intensive, we worked with them over the last year and a half, and we are getting a lot of cooperation. We are getting a lot of "well if we had known that, we would encourage our constituency to fence their cattle out of the streams. Give us information, don't regulate us". I think the research and education has to go hand in hand. For the last 5 - 8% of the recalcitrant ones you need enforceable fines and you have to go in and get tough. You need intensive compliance monitoring programs. You can go a long way with honey in a case like this.

Tarves: I can't speak for the Department of Agriculture and Fisheries but I do know they are concerned about the loading of farmland manures and intense agriculture. They sent R. Burchill over to Europe last year to see what was happening there. More recently, last spring, a representative from a Dutch environmental group was here. Holland, a year ago last December, set a level of loading based on the number of livestock per hectare. If you have more than that number, restrictions are applied to the spreading of manure. Germany and Switzerland only allow a certain number of cattle units per hectare. If you want to exceed that level you may, but you are then taxed on an industrial basis. You just can't compete in the European agricultural community under that condition.

Some of the agricultural practices haunt us for a long time. In the early 1940's, we used copper fungicides on our potato crops. If you talk to the people who do the analyses, the copper levels in carrots and some root crops, are probably higher than we should be eating on a steady diet.

Williams: I am trying to get to the decision makers in the private sector and bring them an ecological perspective. I am really impressed with what the U.S. is doing. I have been on the East and West coasts talking to people. At the Coastal Society Conference in Boston, which is not a high-level group, they had Senators and heads of departments talking to the group. The equivalent to our Minister of Fisheries would be there. We have to start getting to the people who have decision making power. Most of the people I deal with at the working level are very committed and helpful. We seem to be involved in research, I think we have to look for the opportunity and go for it. We have sustainable developments, beautiful vehicles to start educating our politicians to what it means. If they don't plug into the environment right away, sustainable development is going nowhere. Over the last few years especially, I have been very concerned about what has been happening in the Fraser. We are sort of letting it slip away. It is not the people right in the system, working, it is the ones fighting for budgets or policies.

Langer: We fully support the 'honey' vs prosecution approach. But, unfortunately, and this is where you see great leaps being taken south of the border, and you look at some of the monies being spent on Puget Sound versus the Fraser River. Dollars can buy people, cooperation. You have very limited people. If they are educated to do enforcement work, that is probably all they are going to do. So you have to get involved in public education, involve yourself with the Dairyman's Association, with the Nursery Association. Force the pig farmers to form an Association. It takes a little money, but it does take a lot of manpower. We are into a period of down-sizing. We have less people now than we did 3 years ago, and we'll have less people next year that we do now. The time is right to make these moves. Senior government in the western hemisphere talk about sustainable development, endorse the concept, but you have to get a linkage between the working level, the farmers and continue that linkage to the policy makers. I don't know if that can happen in this part of Canada when we are looking at budget cuts. People are not going to start new initiatives. The concept of sustainable development may be a little more than window dressing.

Swain: O. Langer mentioned there is no will to bring the water quality of Boundary Bay up. The Government, last year, issued Water Quality Objectives stating a long term goal was to restore shellfish harvesting in Boundary Bay. My interpretation of some of the court cases is an indication that putting 800 pigs on a 4 acre plot is considered traditional farming practice. Therefore, 'honey' is the only way you are going to get anything done.

McConnell: I think we can do our job at the technical level. That is only going to go part of the way, and in some cases, it is not going to go anywhere unless the political will is around. In terms of information exchange, the technical people have to get their politicians into situations with the American politicians. We must get our public interest groups into position with American groups, and some of the industry groups into position with the industry down there. Then we can start trying to generate that political will, so the technical people can do their jobs.

Armstrong: Up until L. Swain's last comment on water quality, it sounded like you have given up on Boundary Bay. I don't think we have given up on any area. We have areas with closed shellfish beds. Those are pretty visible areas. We are concentrating efforts to improve animal husbandry and trying to get changes. Those are not going to be quick changes, but we have not given up. Because we have a lot of resources right now we can do that. We are trying to keep areas open for commercial shellfish and fish passage. If we have a fish kill more than once in the same area, somebody is going to go in there and look at it closely, whether it is some kind of surveillance or caged fish in the stream. We are not giving up on anything. In fact we are pushing harder than ever.

Walton: A couple of years ago the Provincial Ministry of the Environment did do an inventory of the farms out in the Fraser Valley, and there has been further discussion to do the same sort of work for the Serpentine/Nicomekl areas to see what is in there. About a week ago, the Ministry of Agriculture and Fisheries representative and Brent Moore from our office did meet with the Dairyman's Association to describe what we perceive as the problems there and how they can help out and be part of the solution. So the 'honey' aspect, the public education aspect, is there. Attempts are being made.

Higgs: A lot of the advice Canadian shellfish growers have received from the government is that they should move to areas that are not inhabited, so they can have pristine water. What people find after they move to these desolate areas are increased costs for transportation and lack of facilities that endangers the financial viability of their project. And then, someone can still build a pig farm next door and create water quality problems there.

We should solve the water quality problems where they are, not just move on. If we keep that mentality, we'll run out of areas to move to.

An example is Arcadia Bay in California. The government and public got involved to clean up the area for commercial shellfish production. It is a good case study in what can be done.

2.2.2. BOUNDARY BAY ENVIRONMENTAL CONDITIONS: PUTTING THINGS IN PERSPECTIVE

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For the past four years the U.S. Puget Sound Estuary Program (PSEP) has been determining the existing environmental conditions in Puget Sound. The PSEP has been developing management tools and plans of attack for evaluating environmental conditions in estuaries, as well as initiating pollutant source controls for point and nonpoint contaminant sources. This presentation will include recent PSEP study approaches and findings which will be helpful in putting Boundary Bay environmental conditions into perspective with other Pacific Northwest marine waters. In addition, some trans-boundary issues worthy of joint U.S./Canadian study will be discussed.

Questions And Answers:

Q. You mentioned there is a risk of cancer in eating the seafood in the Sound. Is that based on PAH content or something else?

A. It was based on PCB. We did a risk assessment, which everyone doesn't agree with. It is a conservative model, and very complicated. It looks at the potency of chemicals for causing cancer, it looks at the lifetime of ingestion. PCB's were the chemicals that really made a problem. The risk was 2 or 3 in a thousand increased cases of cancer in a lifetime. But compared to other risks, it is comparable to something like drinking a beer a day or eating a certain amount of peanut butter or drinking so much milk. Those amounts of milk or peanut butter are not unrealistic. If you take the assessment at face value, there is an increased risk. If you look at the other risks in your life, well, it doesn't scare me. At the same time, we can't compare these puget sound species, we caught all these fish with hook and line, to the fish we get at the market, which could be coming from places that are much worse off. I'm hoping next year we can look at some of our market fish, and can look at chicken and beef. There are other benefits from eating fish we all know about. We have some risks

and some benefits. The way it was left in the Sound was that we still monitor these fish. We still recommend people not take bottom fish from industrial areas, but try to fish in cleaner waters. There has been no health advisory or warnings on salmonids. There have been a few advisories for eating bottom fish from Elliot Bay and Seattle and so on.

Q. Is there any correlation between lesions and safety to eat?

A. The lesions were only found in bottom fish. Bottom fish had higher levels of PCB but they weren't a lot higher. We do recommend don't eat bottom fish from industrial areas where we have found lesions, and recommend ways of cooking and preparation. So there are recommendations but there are really no bans whatsoever.

2.2.3. PUGET SOUND MONITORING - WHAT'S IN IT FOR YOU?

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There is wide spread contamination of Puget Sound waters and sediments, as well as losses to biological populations and habitat, as a result of human actions. Tough management decisions which will have to be made to control these losses, including controlling point and nonpoint sources, and tightening regulations on wetlands alterations. In general, managers do not have all the necessary information upon which to base these decisions.

A solid base of environmental information about Puget Sound, its resources, and habitats will also allow us to improve our management of the resources, to provide better technical information as a basis for new regulations, and to chart our progress in source control and cleanup efforts.

We have designed the Puget Sound Ambient Monitoring Program (PSAMP) to meet these needs. This presentation will describe the goals, tools, and uses of PSAMP data, including the development of rules and regulations for source control and remedial action.

With PSAMP getting underway, this is an opportune time for joint strategy sessions and the exchange of samples and data between Puget Sound managers and those in British Columbia.

Questions And Answers:

Q. You implied that for fish monitoring and sediment monitoring you are going out every year. I'm concerned with the cost related to the program, and that you won't have time, after getting the information back from one year to look at it and read just the program. It may be a lot of wasted money the next year or maybe 2 years before you can look at the data and readjust the program.

A. There is an annual review of the entire program, which I neglected to mention. There are times when it is difficult to get the previous years' data back from the lab and Q.A.D, etc. We are trying to put a great deal of pressure on labs and agencies to comply. The initial plan is about a 5 year baseline, although the fish work may not be as long a baseline as some other areas. Then there will be a major reassessment, by an independent group, of the entire program. It is our hope to cut back then on parameters and sample locations.

Q. Where are your likely sources of funding for the research program? Are they private or government agencies?

A. We had hoped to start a research grants program this year with State funds. The State of Washington is not full of funds right not. We are looking to the Federal government and private sources to fund these research priorities short term, and we are hoping to get matching funds from the State. It has to be a coalition, public and private funds. One of the things discussed in the development of the research program was the need to have an independent organization administering this and what they proposed was a research foundation. We are actually in the process of drafting the State and Federal legislation to establish this.

Q. The figures I wrote down say you have State funds being poured in at present to the tune of 3.2 million dollars a year, for the immediate future. The previous speaker said something about 1.5 million, were they Federal funds from EPA?

A. Right now the Puget Sound Estuary Program gets about 1.5 million a year to fund some of the technical studies. The full monitoring program will cost 3.2 million a year. We are not going to get that. We will probably have about 1 million a year phased in. We have about 1 million now and we hope to get up to the full amount, we are looking to the Federal government to augment some of that. The plan is that this would be a State-supported monitoring program. We hope to have a State-supported research program, but we may have to rely more on Federal funding for that.

Q. You mentioned the Citizen Monitoring Program. What type of parameters are the citizens monitoring and how effective are they?

A. We funded about 8 Citizen Monitoring Programs in the last two years as models. The most successful was a pilot project for remote sensing of nearshore habitat areas this past summer, with a concurrent ground-truthing effort. On each of seven sites we had one technician and two or three citizen monitors out, taking quadrants, sampling plants, taking photographs. That was very successful.

Another program had citizens dig clams for PSP analysis. The real key is we pick parameters, digging clams, taking observations, taking water samples for conventional analysis, that do not require complex instrumentation, samples that are not easily contaminated. We don't expect citizens to be in the lab analysing samples. In particular, there are parts of Puget Sound that are very remote from the agencies, it is very resource intensive to get out there on a weekly or monthly basis, and that's where the citizens are involved.

Q. How do you do quality control and quality assurance? I find this very interesting in respect to remote bacteriological surveys.

A. Any group we have contracted with, first of all, we have required a coordinator, who must be good and really on top of it, whether it is an agency person or whether we have paid someone in an environmental group. The citizens must go through training programs where we talk about quality control and so on. Probably the greatest thing is picking parameters that aren't easily contaminated. We keep the volunteers motivated with follow-up workshops, taking the data back to them. Citizen volunteers never have the data first, so there is no problem with them running to the press, interpreting data and getting us all in a lot of trouble. There are quality assurance manuals that have been produced for citizen monitoring, but I feel it is important to keep it simple.

Q. I am interested in the programs you have on research on agricultural runoff. Do you forsee how the information gained is to be applied to control this input into the Sound?

A. As a result of work done a couple of years ago on Watershed Management and Non-point Source Control, the counties were required to look at their watersheds and rank them as far as both beneficial uses and problems, and address source control in each area. One of the problems we ran into was there are many waste management and farm plans in place, but we don't know which ones really are effective. The research focused partially on, are these good F.M.P.'s, are these ones working, if not, how can we redirect those efforts? We want to be able to come up with things like what are necessary buffer widths, if you are going to fence your cattle out of streams, how far out do you have to keep them? What kind of revegetation on river banks is most effective. This fits in very directly with our

Non-point Source Control Program. We work with quite a large committee of agricultural councils. What we hear from them is give us eduction, give us research, but don't give us regulations. This is an area where we think we can hand out a great deal of information and really get them on board as part of the solution.

Q. What about stormwater?

A. That is probably one of our greatest concerns right now. We know early storm water contains every kind of toxicant known to man and a few more. As far as control, we have combined sewer overflows in all our large cities. We are working on separating some of those CFO'S. The problem being that then the storm water goes right into the receiving water. The Atmospheric Study is focusing on storm water runoffs, not so much what lands on Puget Sound from the atmosphere, but what lands on the land and is washed in. We are very concerned. We are looking at a great many new technologies, it is probably going to be one of our big problems in the future.

2.2.4. RESULTS OF 1987-1988 PRELIMINARY BACTERIOLOGICAL SURVEY OF BOUNDARY BAY

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INTRODUCTION

Prior to 1962, Mud Bay, Boundary Bay, and Crescent Beach represented the major commercial oyster producing area of British Columbia. In the winter of 1962, the Department of National Health and Welfare, Public Health Division, conducted a bacteriological survey of these growing waters, which resulted in the classification of Boundary Bay as "prohibited". Median total coliform MPNs at some sample stations in the main growing areas exceeded 700/100 mL. The most notable being the Serpentine and Nicomekl Rivers and the Oliver Road land drainage pumping station. The Serpentine and Nicomekl Rivers were contaminated with domestic sewage, municipal sewage effluent and agricultural runoff while the pollution sources to the Oliver Road pump station was mainly due to agricultural run-off.

The population of municipalities surrounding Boundary Bay has increased dramatically since the bay was closed to commercial shellfish production in 1962. As result of this expansion in population sewage collection also expanded into areas of Surrey, White Rock and Delta that previously discharged sewage to tributaries of Boundary Bay. Therefore a follow-up bacteriological survey was conducted in 1976 by Environmental Protection Service. This survey demonstrated significant improvements in water quality from the 1962 results.

The main purpose of this survey was to evaluate pollution sources to Mud Bay, Boundary Bay and Crescent Beach. A total of 33 marine and 5 freshwater water stations were established with 26 of the marine stations located in the Crescent Beach Area. The remaining 7 marine stations were located at the high tide line adjacent to known pollution sources. The selection of station locations did not reflect potential shellfish growing waters but instead focused on pollution sources, mainly the pump stations. As a result of this survey a portion of Crescent Beach was classified as "approved" while the remainder of Boundary Bay and Mud Bay was classified as "prohibited". This classification was based on limited data given the total acreage involved.

Neptune Aquafarms Water Quality Program

Due to its interest in commercial shellfish operation in Boundary, Neptune recently conducted a two year water quality program in support of its application for shellfish leases for a portion of Boundary Bay. The area is currently under closure due to the results of the 1976 EPS survey.

The aims of the Neptune program were as follows:

1. investigate the known pollution sources to determine their relevant impact on water quality.

2. investigate the water quality characteristics at stations that reflect growing waters, i.e. low tide areas

3. evaluate the relationship between changes in water quality and precipitation patterns.

During the period from November 1986 to November 1987 monthly samples were collected at five pump stations (P1 through 5), five Marine Stations (M1 thru 5), three tidal channel locations (SA, SB, SC) and two streams (S1 and S2), Serpentine and Nicomekl Rivers respectively. From November 1987 to May 1988 monthly samples were collected at five additional Marine Stations (M6-M10) located south of M1-M5 plus samples were collected from the tidal stations and the creeks as before. Samples were not collected from the pump stations during this second period.

A description of Pump Station Locations is as follows:

P1 - Third Ave (Beach Grove) Capacity of 8,000 Igpm
P2 - Twelve Ave (Beach Grove) Capacity of 15,000 Igpm
P3 - Boundary Bay Airport Capacity of 8,000 Igpm
P4 - Beharrel Pump Station Capacity of 20,000 Igpm
P5 - Oliver Street Pump Station Capacity of 35,000 Igpm

The locations of all Stations are marked on Figure 1.
The results of the program are summarized in Table 1.

Conclusions:

Based on the results the following conclusions have been made:

1. The Pump Station discharges are major sources of pollution to the Bay. Upstream investigations are required to locate and clean up the sources of pollution to these stations.

2. Marine Stations adjacent to the Pump Stations experience elevated levels of fecal coliforms during high precipitation events.

3. Water quality improves rapidly in response to a change from high precipitation events to dry weather conditions.

4. Intertidal portions on the south side of Boundary Bay near zero tide exhibit water quality characteristics suitable for commercial oyster production.

Questions And Answers:

Q. What needs to be done?

A. Our focus was on marine water quality. Once we could identify a pollution source, we really didn't do too much more than that. If we came up with a number in a stream that was draining into a marine water, where the count was up high, we would look for an obvious source. If we saw a pasture, farm or what not, that would be included in the notes and nothing more would be done about it. That was not the responsilibity of the shellfish program.

What needs to be done, basically, is to go up the pipe on these sources. To actually do a profile on those areas and look at remedial work that can be done.

In Drayton Harbour there has been a fair amount of initiative. The Dakota Creek drainage has been looked at in detail, every farm has been looked at and the pollution sources identified. The same sort of program needs to be done here. There is a tendency for people to point fingers. Without detailed information you don't know what you are dealing with. It is too easy to comfort yourself with the terminology "nonpoint". There is a point. It is difficult to find, but it is still a point.

Q. How did you hold the oysters in the Bay to avoid vandalism?

A. The Sentinel samples? You would have to be pretty diligent to find them. It is about a 3/4 mile hike in the mud to get there, and a wide expanse with a few oysters. They are pretty difficult to find. The other thing is to look at the low tide situation in the winter when oysters are good to eat. If someone wants to eat oysters in the summer, well, they're not too bright.

Q. You have indicated a lot of the pollution comes off the farms. There is a heavy population of waterfowl out there. Have you considered what the fecal coliform count might be from the waterfowl?

A. I have not looked at it there, but I did do some rough numbers in Drayton Harbour on waterfowl. Basically the birds aren't big enough. It takes a lot of them, compared to farm animals, the daily fecal contribution is massive compared to a bird. It takes a large flock of birds to have much effect.

Q. What is the marine mammal population of Boundary Bay?

A. I don't have any experience with that.

Q. During heavy rainfall, does White Rock have raw sewage overflows?

A. I believe they have corrected that problem. If there is, it would be into Semiahmoo Bay, not into Boundary. There is a pump station they have been upgrading but I don't believe they have had any problem. They have been under the gun to correct that. They wanted to open up Semiahmoo Bay for recreational use as well and didn't want to have a shellfish closure sign on the beach.

Q. Regarding the samples at P-4 and P-5, were they taken pre-discharge or post-discharge? Was any work done downstream from the pump station, say 100 feet out?

A. They were taken just upstream from the pump station, pre-discharge. There were not really any immediately post-discharge. The marine station was taken at high tide, but that would have been a fair distance away.

Q. I'm not here to extoll the virtues of farmland. Having fecal contamination that comes up in our data at 25,000 or greater means we have sewage, raw sewage gets up to 100,000 or into the millions.

A. Where my numbers show 1,600, it means greater than, we have no actual number.

C. Regarding the question about White Rock, the GVRD has the system in place. I do not believe there have been any major blow-outs relating to bathing beaches. There may be one in the Mud Bay area, but you would have to ask the GVRD.

Q. The GVRD Liquid Waste Management Plan has been concerned that from the upland residential area there has been a fair bit of contamination. In your talk you tend to implicate the agricultural run-off. Do you have any feeling as to the relative impact you expect from agricultural run-off vs urban run-off?

A. Basically, looking at the population of animals vs people, the total daily fecal contamination from that number of animals relative to the total fecal count from humans, it is not enough. Usually what happens with sewage pollution from humans is some sort of failure, such as a septic tank fails or a stormwater connection to the sanitary, or one of those sorts of things. It is not a direct input. With farm animals, it tends to be a direct input. There is no mitigation whatsoever. Unless the municipality is not picking up sewage and there is an obvious raw sewage discharge, which your profile up the creek would find, then I believe it is all animals. The predominance of fecal streptococci in the data points to that as well.

Q. You talked about too many animals and not enough land, but you didn't mention any remedial measures.

A. Something done in lots of jurisdictions in the States has been to separate the water course from the animals, where water runs through the farm yard, in stock piling manure in areas exposed to a high flow of water there are a number of practices that can be done. They spread manure only at certain times of the year, so they have to stockpile it prior to the spring. During the winter the fields are too wet for them to spread on.

C. The Dairy Farmers Association have an ad hoc supervisory committee, that when problems are identified, they will go talk to the dairy farmers themselves.

Q. What about the feedlots?

A. Possibly, I don't know about feedlots.

Q. What is the prospect for treating this material? Do you suggest point source collection and treatment and at what cost?

A. Considering the flow rate and the hi flows, it would take a major investment by somebody. At about 1,000 gal/min it would require a large plant. We're not looking for pristine water. What we have to do is take out the gross contamination. That is probably enough to bring the Bay back into the state where it can be used for commercial operations, with some controls. I think that is where the focus has to be. It is still going to be under some controls because of the proximity of the population. Even something like a chlorine dosage is a very large expense.

Q. I would think you'll have a very difficult time determining how serious the problem is if your upper limit is 1,600. There seems to be a lack of information on the oyster tissue itself.

A. The focus from our point of view is the requirements for shellfish areas, which don't recognize oyster meats, unfortunately. Oyster meats are a good indicator, but they won't be used by a regulatory agency in opening or closing an area. Water quality drives the regulations. There is quite a controversy about the water quality in the growing water as opposed to water quality adjacent to a known pollution source. It is easy to set up a sampling program and close an area if you set up 3 stations close to a known pollution source. There has to be a set-back from known pollution sources. In Drayton Harbour, we have two known sources of pollution from creeks that can give marine counts above the limit while the rest of the Bay is perfectly clean. To close the entire Bay because of those two stations does not make sense.

2.2.5. WATER QUALITY STUDIES IN DRAYTON HARBOUR AND NORTHERN PUGET SOUND

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Abstract not received.

Questions And Answers:

Q. Are there salmon stocks in Dakota and California creeks, and if so, is there any monitoring on escapements?

A. There is an enhancement group there that has egg boxes and things of that type. Escapement on natural production would be difficult because now they are putting extra numbers in. To my knowledge there is no systematic record. The problem is they just don't have the manpower to do these studies for any length of time. It would almost have to be a volunteer effort on the part of the enhancement people. These projects have only been going for about 2 years. You hear stories that you used to be able to walk across all these streams on the backs of fish. We know numbers have dwindled, and probably pretty severely.

Q. What are the species?

A. They have chinook, steelhead, chum and coho. There is pretty well everything in Dakota Creek. Drayton Harbour makes an excellent nursery. There is a lot to feed on with the eel grass beds.

Q. You mentioned the good oyster conditions in the Bay, especially adjacent to the two creeks. Is oyster harvesting permitted?

A. The oysters aren't grown at the mouth of the creeks, they are almost a mile away.

Q. The coliform counts are good enough to permit that?

A. There was just one storm sample that I took that exceeded the level, which is 14. The Department of Social Health Services goes in there and does the testing, and they threatened closure, they call it borderline, but it is still open.

Q. Does your sampling program go on a yearly basis, and is that just at the creek mouths?

A. It is monthly, year round. There were 12 stations, in the Harbour, one at each creek mouth, just above tidal influence at each creek, at a ditch discharging from a golf course, one at a discharge from the wetland along the boundary of the Harbour that flowed in.

Q. So you are taking various input sources along with marine sources in the Bay area.

A. There was one outside the Harbour in Georgia Strait. In the Bay there was one at Semiahmoo Marina, one at the mouth of the Harbour, below the City of Blaine, at the mouth of the two creeks out on the mudflats, and one below the golf course. As well there were two storm samples of three days each.

Q. How are the salt water fecal coliform levels?

A. The only time it went above certain criteria was during that one heavy storm, and there had not been rain for about 3 months before that storm.

Q. What is your standard for oysters and fecal coliform counts?

A. It is 14 organisms /100 mL, a geometric mean.

Q. The protocol is quite explicit. It is not just one number. It is 15 samples, supposed to be taken from the worst case condition. The 14 mean is one number, the other number is a 90 percentile of 43, or 90 percent of the samples must be below 43. What you usually find with most of these stations is that they all meet the geometric mean, but they fail the 90 percentile.

A. They usually sample in September every year when its pretty dry.

Q. Are there any auto wreckers along the waterfront near where you are finding cadmium, and if it may come from catalytic converters being dumped.

A. Not that I know of. There was one area I was told of, along one of the streams where a person had a bunch of old car bodies. That was on somebody's private property. There is no formal auto wrecking place.

C. There is intermittent heavy activity at the boat yard mentioned. They may be building a boat for three months and then have nothing for a year.

C. The samples at the mouths of the creeks, in marine water, can show counts above the standard. A lot of the problem is in how you interpret the data. It's easy enough to find high counts at the mouths of the creeks and then close the entire Bay. For instance, station 9 is adjacent to the haulout area for the seals, which can show high counts. Station 10 is at the mouth of the Blaine Marina. It is interesting to look at tidal flushing action. The Blaine Marina is held within an embankment, so it fills at high tide and anything in the Marina has to stay there and can't pollute the Harbour. Then at low tide, the Marina empties with the rest of the flow. So the Blaine Marina has a tough time contaminating that Bay.

A. We did take one sample below the Harbour House Restaurant. We had reports someone was putting out contaminants and they probably were with what we got. There was one sample out in the Georgia Strait, and we had one at a drain that comes off the Semiahmoo Spit, and some others.

The flushing action on the southwest side is a lot less than it is in the rest of the Harbour because it is very shallow there. Fisheries required erosion control dams on the hillside about two years ago. I don't know how effective they are. One of the other things we found at one spot was high nickel levels. I don't know the source of that. Historically this whole area was used for canneries and other industries, so there could be a lot of stuff there. The Georgia Pacific used to have a hazardous waste site right where TRC was. When they were viewing Silver Creek as one of the early action watersheds they sent a sediment sample to the E.P.A. The nickel level was among the top 15 in the country. There was also, along that creek, a copper tubing plant and copper was high. For dealing with

heavy metals it pays to do some historical research to identify former industries and locate dumps. There was a dump along Marine Drive. They wanted to put a Marine Center there and when they took methane levels they found some gas. If you have an old dump, before they started using pesticides and DDT, it wasn't too bad. There would be, essentially, less harmful wastes. Once they started using pesticides and herbicides we can really run into problems. There used to be a dump along Marine Drive, right across from that mini-mall. It was just covered over. If you go down the shore you can see bits of paper and stuff oozing out of there still.

2.2.6. RECREATIONAL WATER QUALITY MONITORING FOR BOUNDARY BAY BEACHES

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The Boundary Health Unit's jurisdictional area encompasses the municipalities of Surrey, Delta and White Rock. Since the 1960's the Boundary Health Unit has monitored the recreational water quality of Boundary Bay beaches. Each summer, four main beach areas are monitored: White Rock, Crescent, Centennial and Tsawwassen.

The mandate of the Health Unit is to protect the public's health by ensuring that all recreational beaches under our jurisdiction meet or exceed the requirements of the Canadian Recreational Water Quality Guidelines. Currently, fecal coliforms are the bacteriological water quality indicator organisms in use by the B.C. Center for Disease Control. The Health Unit has at present thirteen (13) permanent water sampling sites in the Boundary Bay area. These sites are sampled weekly and the results obtained are used to calculate a running geometric mean for each site. In 1988, 71% of all geometric means calculated fell below the 50 fecal coliform/100 ml level. Further, 96% of all geometric means fell below the 100 fecal coliform/100 ml level, and finally all geometric means (100%) fell below 160 fecal coliforms/100 ml. The health risk indicated by current fecal coliform levels at Boundary Bay beaches appears to be in general quite low.

In August, 1988 several hundred thousand gallons of raw sewage spilled into Drayton Harbour from the rupture of Baline, Washington's trans harbour sewer line. Due to the high potential health risk, the Boundary Bay Health Unit declared the White Rock and Crescent area beaches contaminated and temporarily unfit for swimming.

The benefits of a recreational water quality monitoring program are numerous, ranging from immediate health risk evaluation to long term drainage

improvement planning. Lastly, the Health Unit's future goals are to increase public awareness of fecal coliform counts at local beaches along with improving international emergency response measures.

Questions And Answers:

Q. I noticed your data for August 15 had high values for a number of sites. Do you have any reasons for this? Also, some of the fecal coliform being picked up in your analyses are likely from agricultural sources on the Nicomekl River. How would this affect your data?

A. In answer to your first question, I think it is just a matter of statistics. No trend was identified. The study area is quite large, and the sites are not close together. Usually fecal contamination is more localized. You would see neighbouring sites with similar values.

As for your second question, fecal coliform from agricultural sources would not indicate a harmless situation. Animal feces can be a public health hazard also, with regard to salmonellosis and a variety of other "osis". Any fecal contamination should be taken seriously and analysed from that aspect.

Q. How long did it take to sample the 13 stations, and how did you plan it relevant to the tide?

A. It usually takes 2 1/2 hours to do the 13 sites. If we catch the tide coming in and take it as it's going out, it's usually pretty good. At low tide you would have to walk out up to a mile at Centennial Beach for instance.

Q. As the tide is coming in you pick up a lot of sediment of course, and we know there are fairly high levels of fecal coliforms associated with sediment. Wouldn't that bias the samples taken as the tide is coming in compared to those taken when the tide is going out and sedimentation has occurred?

A. Sampling procedures recommend a variety of samples, both incoming and outgoing tides, you just can't always get that.

Q. Is there a recreational harvest of shellfish, and if so, is there any monitoring to make that a protected situation? Also, is there any reporting mechanism for water-related, either swimming or shellfish, disease. Do you have doctors reporting or do you have any real way of knowing how much G.I. disease there is?

A. Fisheries deals with shellfish. For the last 20 years or so, the beaches have been posted as unsuitable for the harvesting of shellfish. Shellfish concentrate bacteria and viral organisms due to filter feeding, and would

have significantly higher concentrations of these organisms than is reflected in the water quality data. The Health Department has really nothing to do with monitoring shellfish, the Fisheries Department may have records. At present the area is closed, and I assume it will remain closed for quite some time.

At present there is a reporting mechanism where all G.I. infections in the local communities are reported through lab reports as a mandatory requirement under the Health Act. We do a follow-up investigation as to probable source of each communicable enteric disease in the community. There is nothing specific to tie this to recreational water quality. It could be from a variety of sources.

2.3. UPDATE ON FRASER RIVER ESTUARY ACTION PLANS

2.3.1. AN UPDATE OF THE FREMP - ENVIRONMENTAL REVIEW COMMITTEE ACTIVITIES

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One of the first programs implemented following the signing of the FREMP agreement was a Coordinated Project Review Process, which commenced operation on January 6, 1986.

In order to make such a process possible, it was necessary for all review agencies having regulatory responsibility for developments in the estuary to agree to a Common Application Form. In addition, it was necessary to identify lead Agencies to act as focal points for proponents in the desired one-window review process. It was agreed that the lead Agencies should be those agencies with the authority to grant land or water tenure to proponents at their project sites, as this is the most fundamental decision to be made for any project. No tenure - no project! In the case of the Fraser River Estuary, this means that the lead Agencies for any project is almost invariably one of the following:

Fraser River Harbour Commission
North Fraser River Harbour Commission
Ministry of Crown Lands.

In cases such as maintenance operations, where no form of additional tenure is being sought, the FREMP office acts as lead Agency.

A key element of the Coordinated Project Review Process is the Environmental Review Committee. This committee is responsible for advising the lead Agency on environmental aspects of proposals, based on input received from participating environmental agencies. It is a four member committee with representatives from Environment Canada, Fisheries and Oceans Canada, B.C. Fish & Wildlife Management and B.C. Waste Management. Since the outset, the committee has been chaired by Environment Canada.

The process works as follows. When a Common Application Form for approval of tenure for a particular project is received by one of the lead Agencies, it is forwarded to the FREMP office. The project is incorporated into the FREMP project review filing and record keeping system, known as the Central Project Registry, and is distributed to all potentially interested agencies for review and comment. Comments are returned to the Central Project Registry by these agencies. A 30 day turnaround time is targeted for this stage of the process.

When all of the environmental agencies have responded, the Environmental Review Committee peruses them and draws up environmental recommendations for the use of the lead Agency in making its decision regarding tenure for the project. These recommendations are usually incorporated into the decision statement issued to the proponent by the lead Agency. The comments of the non-environmental agencies in the process are not reviewed by the Environmental Review Committee but are passed on without comment to the lead Agency, together with the environmental agency comments and resulting Environmental Review Committee recommendations.

The process has worked well to date, with over 300 projects processed since the start-up date.

Questions And Answers:

Q. The FREMP study area includes the Banks and Boundary Bay. Do you also review Boundary Bay?

A. We review projects throughout the Fraser River Estuary area, which includes Boundary and Mud Bays, and the Serpentine and Nicomekl up to the floodgates.

Q. There were Salicornia harvesting proposals for Boundary Bay, what came out out of that?

A. We had no formal proposals this year. Last year there were several proposals to harvest Salicornia in Boundary Bay. There were a number of proposals to harvest Salicornia at various areas of Vancouver Island, where the bulk of the harvest comes from at this time. We had three

expressions of interest, two of which turned into formal applications. At that time we were not in possession of any hard data with respect to the environmental impact of Salicornia harvesting. For this reason we chose to turn down the second of the two proposals, on a first come first served basis. We made an agreement with the other proponent, who had been harvesting for some time without a permit, that he would cooperate in a research effort. Unfortunately, Dr. Hutchinson could not be here to present that information. It is a two year program. We are expecting further applications and we will probably approve one harvest license in Boundary Bay, purely to continue the research. There will be no decision to open Boundary Bay to harvest until the research is concluded.

Q. Are you using specific Environmental Impact Assessment protocols in your review process?

A. No. The function of the committee is not to review per se, it is to consider the comments and recommendations made by individual agencies under their mandates. We synthesize all the recommendations and suggestions received, into a set of recommended actions for the benefit of the lead Agency. We are not assessing the project, we are assessing the comments. It happens that some of us also generate the comments. I do most of the letters for Environment Canada, in consultation with CWS or IWD or whoever. When you put your Environmental Review Committe hat on, you are not reviewing the project, you are assessing the comments and making recommendations accordingly.

2.3.2. ACTIVITIES OF THE FREMP HABITAT WORK GROUP

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The FREMP Habitat Activity Group is in its third year of work. In 1986/87, the Group established its workplan and project work began in 1987/88. The basis of the habitat plan is to achieve a no net loss of existing habitat and through restoration and development, aim for a net gain in fish and wildlife habitats.

Early in the process it was realized that the intensive management of habitat in a large metropolitan area required detailed inventory information.

Consequently, all marshes, mudflats and riparian vegetation habitats have been mapped on 1:2500 scale maps. All habitats are then classified into three colour codes. RED coded areas are of high habitat productivity/sensitivity and are considered conservation areas. Habitats of lower productivity/ sensitivity are coded YELLOW. In these areas, industrial development may occur but compensation habitat must be built in an approved area. Areas of the river that have low habitat values (eg. riprap areas, industrial foreshores, etc.) are colour coded GREEN. Industrial development may occur in these areas with normal mitigation techniques (eg. proper timing, clean construction, etc.).

As part of the inventory, all habitat restoration and enhancement options are listed. The Habitat Group will issue a final report incorporating the habitat inventory/classification maps and outlining all habitat restoration/ enhancement options. Also, the long term requirements for enforcement and trend monitoring will be defined. As a final product, guidelines will be developed which will outline acceptable types of industrial developments compatable with the habitat classifications. Once this is all addressed, a habitat management plan will be in place similar to the recently developed DFO-NFHC North Fraser Environmental Management Plan.

2.3.3. HABITAT INVENTORY AND CLASSIFICATION OF THE FREMP AREA (EXCLUSIVE OF NORTH ARM)

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The Fraser River Estuary Management Program (FREMP) is undertaking a biophysical inventory and classification of habitat types in the Fraser River study area as part of the Habitat Management Activity Program. Upon completion in March 1989, there will be a total of 60 maps at 1:2500 scale and 12 maps at 1:5000 scale covering the Fraser River Main Arm to Kanada Creek, the Pitt River, Sturgeon Bank, Roberts Bank, and Boundary Bay. Each map shows various categories of intertidal habitat (marsh, treed and shrubby riparian vegetation, mudflat, sandflat) and outlines their size and location. These 24 by 36 inch large maps have been carefully ground-truthed and therefore represent the most accurate habitat maps available to date for the Fraser River Estuary. Also included on the maps are the FREMP area designation categories. Shoreline classification is being done by representatives of environmental agencies (DFO, DOE, MOE) according to three color codes (red, yellow, green) which correspond to three levels of habitat value (high, moderate, and low productivity). These color codes will serve as a guide for the type and degree of development that will be permitted along the Fraser River foreshore.

Funding Agencies: Fisheries and Oceans and Fraser River Harbour Commission
Administrative Agency: Fraser River Estuary Program

Questions And Answers:

Q. You are presently mapping the Main Arm system. I assume the next step is to categorize it with the red, yellow, green, color code and then get agreement with the FRHC to get in place a strategy similar to what you have with the NFHC?

A. We always strive to obtain agreement. We have learned a lot over the years. You cannot delegate habitat to someone who wants to build docks and ports, you can only go so far. DFO has reserved the right on the final say on what is red versus what is green. It won't be a total concensus. At times there will be some disagreement and some compromise. The agency with the mandate to protect the habitat has to have the final say on what areas are to be protected and what can be given up.

Q. What sort of time frame is involved before this agreement is in place?

A. The North Fraser one was signed in October and is in place. The main Fraser one has a great funding problem because FREMP is not a money bag organization. They did give the Habitat Group the largest allocation of any of the activity groups. As an indication of the cooperative good will of the FRHC, they donated twice as much. This year we are working on a 70 or 80 thousand dollar budget. All the inventory work has been done and, all the field work has been done in one year. The classifications are in place, so it is really just a matter of Ron going into the production of the maps.

Q. When you are looking at compensation ratios, you have marsh replacement at 2:1, when you get to riparian vegetation you have 1:1 on a linear basis. Your rationale for the marsh is that it takes 5 years to get a reasonable marsh established at a productive life stage. I would argue that looking at some riparian vegetation like alder trees, it could be 20-30 years before they are dropping leaves and contributing to the nutrient system. Rather than a 1:1 ratio, maybe it would be a 5:1 ratio to establish mature riparian vegetation.

A. I agree. That was discussed. Linear space is a real problem in many areas of the River, with the type of foreshore available. We thought with tree planters we could bring in decent sized vegetation. With large trees, in many areas we ran into tremendous problems with the dyking authorities, which are Federal, Provincial and Municipal. In many areas, they are trying to get rid of trees over 6 inches in diameter. In a lot of areas, therefore, we would be going for willows and lower vegetation overhanging the water. Riparian habitat is fairly stable from hydraulic forces, where a marsh could disappear in the next freshet, so there is a much greater risk. Part of the 2:1 addresses risk, and I'd like to think the bank should stay in place.

Q. What depth is your riparian mapping from the foreshore?

A. It is basically a minimum 5 meter strip. From an environmental aspect, that is probably inadequate, but FREMP does not have any legislation behind it. For much of what we are doing we have to rely on the Federal Fisheries Act. We are looking at bug drop in the estuary, we are not talking about a watershed and hydrologic impacts such as logging on the Chilliwack River. I suppose there could be some raptor trees, but the wildlife people don't have the legislation to say, we want those trees that are 50 feet back of the dyke. We have gone along with Fisheries where we have the legislation to push.

Q. How do your recreated marshes compare to the natural marshes in species diversity or in time to come close to natural marshes.

A. It is too bad Colin Levings is not here. One of our first big artificial creation of marsh was in the Campbell River Estuary on Vancouver Island. After 5 or so years they are up to 70% of the productivity of the control area. Obviously they produce invertebrates. We are using native species from an adjacent area. In the Bridge Point development, the actual substrate and the plants were salvaged. You are dealing with the same arm of the River. There is no reason at all why it shouldn't take and be very similar or identical. At 2:1 it is possible to come back in 20 years and there will be a net gain.

Q. You mentioned one of the activities is experimental management. Have you considered building these artifical marshes experimentally to get information over time which will let you build marshes which are potentially more valuable to fish?

A. The management people put that in there. In time a lot of these things would have been done anyhow, whether FREMP existed or not. Now you throw it in under part of the program. You take Tilbury Island for instance, and Westwater is well aware of that study, where the B.C. Development Corporation started filling in, and money was set aside to compensate, and it entailed restoring an old farm back to aquatic productivity, and how do you do that? Do you build channels through an old marsh, should you dredge out large lagoons? Some of these things are being done. I'd say the jury is still out on these projects. What is most limiting, is it the food production in the estuary or is it living space? Maybe we could produce a lot more salmon. There are a lot of things our research people have to address, and it may take us 50 years to get some real answers. Hopefully we can compress it down to the next decade or so, because we need some of those answers now.

2.3.4 AN UPDATE: FREMP - WASTE MANAGEMENT ACTIVITY PLAN

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The mandate of the Waste Management Activity Program and the status of the Activity Program Plan was described. A report has been prepared that discusses the legislative background for waste management in the Fraser estuary; the background and context of estuarine waste management including the natural characteristics of the Fraser, the nature of contaminants, and information and monitoring initiatives. Also discussed in the report are estuary wide issues such as special wastes, compliance, and enforcement. The main body of the report discusses the characteristics, issues, initiatives, options and suggested activities for a number of areas of concern. These areas of concern were defined as sewage treatment plant effluents, industrial effluents, urban runoff and combined sewer overflows, agricultural wastes and rural runoff, groundwater contamination, and miscellaneous wastes, and the major issues for each were discussed.

Note: Copies of the full presentation are available from the author.

Questions And Answers:

Q. How does your program view these large ditches which are carrying storm water? So far we have been concerned about them at the end, as they are reaching and polluting the estuary. When you look at these ditches you see wildlife use them and quite a number of the public view these ditches as recreational areas. As far as I know, no one does environmental or health studies on the ditches themselves.

A. P. Khare is the Chairman of the Waste Management Activity Program, and I (B. Langford) have been helping him, with Mike, in writing a report. The draft is completed now, with maps, etc. and is very extensive. That report is going to the full committee for review and we hope to have the final draft to the FREMP executive in early April. At that time it will be a public document and will be available to everybody.

In answer to the question, there have been studies done on agricultural runoff to ditches. Unfortunately they were not set up properly. Considerably more work has to be done on agricultural and pesticide runoff to those ditches. In our terms of reference, we have included these areas in our study, in terms of entry of ground water to these areas or runoff to them, particularly for the agricultural, pesticide and organic material that comes into them. That is an area we are looking at and we have made recommendations concerning them for more studies.

Q. These ditches are not simply works carrying contaminated water. They themselves have environmental and recreational uses which no one seems to be looking at, as far as I know.

A. I can only answer for the Waste Management Activity Program, we are not involved in the recreational side of it, there are committees that are responsible for that.

Q. As far as I know, our boundaries stop at the edge of the estuary and they don't go up the rivers, they are someone else's jurisdictions.

A. Our definition of our study area includes any area where water could be contaminated and eventually end up in the Fraser River. We don't consider the boundary of the river itself as our study area.

Q. Three other sites I suggest you may wish to at least document would be groundwater contamination at the Annacis and Iona sewage treatment plants, where there would be sludge lagoons, and the Dow-Chatterton site where there is some groundwater contamination.

A. One we have looked at, one we haven't. We found there is a lack of information on groundwater contamination. Although it does not seem appropriate to always say more work is needed, this is often the case we have found in terms of groundwater, agriculture and pesticides and some of the industrial effluent. Although there are literally thousands of reports out there, we have found there are still pieces of information missing.

C. There is monitoring information for the wells around the lagoons at Iona. I don't think there are any wells around the lagoons at Annacis.

2.3.5. AN UPDATE FREMP - EMERGENCY MANAGEMENT WORK GROUP ACTIVITIES

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In May 1984, the FREMP Review Committee prepared a document entitled "An Implementation Strategy for the Fraser River Estuary Management Program". The strategy consists of three components, one of which relates to the implementation of a number of coordinated activity programs to improve resource management.

One of these activity programs is Emergency Management, the objectives of which are to be able to respond to emergencies in a coordinated and efficient manner and to prepare a coordinated emergency management program.

In July 1986, Environmental Protection (EP) agreed to be the lead agency in addressing the above emergency management activity program and, in consultation with appropriate federal (including the Department of Fisheries and Oceans), provincial and other agencies and interests, to produce an emergency management plan for the Fraser River estuary.

A commitment was given by EP to prepare a draft discussion document on the environmental emergency plan. Beginning in October 1986, meetings were held and draft discussion papers prepared by involved agencies and interests. As part of the review of the discussion document, the Environmental Emergency Management Activity Working Group was formally established in April 1987.

A final discussion paper was prepared in June 1987 and submitted to the FREMP executive and participatory agencies. The discussion paper represents a concensus among working group members as to the present status of emergency management in the estuary, proposes a lead agency agreement and makes nine other recommendations on measures that could improve environmental emergency response on the Fraser River estuary. A proposed work plan was submitted to the FREMP executive as part of the discussion document and identified the need to undertake a number of studies addressing issues related to emergency response in the estuary.

One of these studies was a proposed assessment of the suitablility of oil and chemical spill countermeasures equipment for use in the lower Fraser River. Counterspil Research Inc. was subsequently contracted to prepare a report on the feasibility of establishing a spill control equipment package for the lower Fraser River, a coincident training program and associated recommendations. This report was completed in March 1988 and provided to the FREMP executive and interested parties. Briefly, the report indicated little optimism regarding effective and successful oil spill countermeasures in the mainstem of the lower Fraser River.

A number of initiatives regarding environmental emergency response in the Fraser River estuary were identified by the Working Group in their 1988/89 work plan and included: assessment of all agency and industry contingency plans applicable to the lower Fraser River; evaluation of the physical behaviour of oil slicks in the lower Fraser River; preparation of a spill training program; and development of guidelines for marinas and small craft harbours.

The Working Group will continue to develop and priorize environmental emergency management needs for the lower Fraser River and estuary and pursue opportunities which would facilitate the successful completion of studies and needs which are considered important.

Questions And Answers:

Q. Why is Surrey not on the management committee? Did they not want to be on it or were they not asked?

A. I'm sorry, you would have to talk to M. Flynn or someone else on the committee.

2.3.6. STATUS OF THE GVRD LIQUID WASTE MANAGEMENT PLAN

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The LWMP is the latest step in updating the Region's master severage and drainage plan to account for the Region's growth over the next fifty years. The District has just completed the first step (Stage I) in the planning process, and has set out a range of options, including costs, for potential upgrading of wastewater facilities. Stage I shows that region-wide programs to upgrade sewage treatment, combined sewer overflow controls, and stormwater runoff controls could cost $1.5 billion. However, because costs are so high, more work needs to be done to determine upgrading priorities to ensure that

maximum benefit is achieved for the money spent. In particular, a comprehensive environmental monitoring program is required to establish baseline environmental conditions, identify hot spots in receiving water, and establish water quality objectives for use in designing wastewater facilities and managing the environment.

In addition to actions by the District, the Stage I plan also shows that action is required by the Federal and Provincial governments to reduce the levels of contaminants in the Fraser when it enters the Region, implement a facility for handling special or hazardous wastes, regulate agricultural management practice, and implement an ongoing comprehensive envionmental monitoring program.

Questions And Answers:

Q. What constitutes a red flag for contaminated water, say at Centennial Beach? What was the study based on, how many samples, over what period of time?

A. We gathered existing data. We contracted Coastline Environment to go around to various agencies and gather whatever data was available, prepare an inventory, and do some preliminary assessment of the data. There was no going back to validate the data or to check for accuracy. We made a broad appraisal of the quality of the data. The data came from Waste Management, Environmental Protection, whenever it was available. In terms of the red and green, there were some good water values. It was a qualitative judgement to do some kind of classification. If we classed something in good condition, that was where Water Quality Objectives were being met. In English Bay, the cutoff would be the recreational water objective 200. In Boundary Bay it would be the same. In the Fraser River it would be irrigation water quality.

Q. How much of the sludge that comes from Iona is actually utilized?

A. Not very much. It is not even close to the amount that is going in. We have had a series of private ventures trying to take the sludge, process it and market it. All of them have had difficulties of one sort or another and have folded. The last one was just last year. In all cases they have been treating a small piece of the total quantity. The mountain has been getting bigger.

Q. What about Milorganite?

A. We are getting a better quality than Milorganite, but it is a question of trying to find a market for it and make it financially viable for some of these groups.

2.3.7. IMPLEMENTATION OF THE NORTH FRASER HARBOUR ENVIRONMENTAL MANAGEMENT PLAN

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On September 7th, 1989, the North Fraser Harbour Environmental Management Plan was signed by the Chairman of the North Fraser Harbour Commission (NFHC) and the Minister of Fisheries and Oceans. Soon after the signing, a meeting was held on September 28 between George Colquhoun, Port Manager, NFHC, Otto Langer, Head of Habitat Management Unit, Fraser River, Northern B.C., Yukon Division, Department of Fisheries and Oceans (DFO), Kevin Conlin, DFO, and Gary Williams, consultant to the NFHC. During the meeting a work plan for the first year was determined and Messrs. Williams and Conlin were delegated to compile the technical information necessary to implement the main components of the plan, which would be reviewed by the NFHC.

The Plan consists of four main components:

1. shoreline habitat classification;
2. habitat assessment guidelines for developers;
3. habitat compensation banking;
4. Cooperative Management Plan.

Implementation will involve initiating activities for each of the four components. The shoreline habitat classification has been modified based on field work done in September 1988. Guidelines will be prepared to advise developers on habitat assessment, mitigation and compensation. Criteria have been developed for selecting candidate areas for habitat banking sites and a prioritized list prepared has been submitted to the NFHC.

Under the cooperative Management Program several water quality improvement action items have been approved by the NFHC and DFO. A harbour patrol environmental surveillance will be implemented in the near future to identify locations and notify the appropriate agencies of environmental infractions (i.e. illegal intertidal filling, spills, illegal discharges, fish kills, unpermitted fish kills, etc.). Federal and provincial agencies supportive of the initiative and notification, response and follow-up procedures will be developed shortly. The NFHC has recently acquired a GIS computerized mapping system, and a hazardous materials audit for the North Fraser Harbour will be compiled and put on the system.

To enlist the support and participation of industrial and public harbour users in improving the environmental quality of the harbour, a harbour keeping brochure will be produced to inform people of the intent of the Plan and solicit their cooperation. A harbour keeping workshop is also planned for later in the year to further increase participation in the Plan.

Questions And Answers:

Q. At one point in the Plan there was a water quality proposal, what happened there? Secondly, a question about the FRHC habitat bank. How does industry pay for habitat it takes out of the bank, that the taxpayer has established? Do you suppose the FRHC is likely to take on the plans from the NFHC?

A. I did a draft report on water quality issues for the North Fraser Harbour. It was not well accepted, as obviously the Harbour Commission does not have jurisdiction in that area. As well it was a relatively "eco-freaky" report. We realized water quality was not our mandate, so we had to backtrack a bit. We still are very determined to have a positive impact on improving water quality through working with industry.

The way habitat banking works, in theory, is that the Harbour Commission will create habitat, say marsh, and they will sell that habitat under certain conditions. For instance, in our plan, only areas that are developed in yellow areas can draw on that bank. The cost to the developer will be the cost to develop that habitat. The benefits to the developer are that the habitat is there to be used, he doesn't have to use 'development time' to find consultants or choose areas or build it. As for the FRHC, we have been in constant contact with them. This banking thing was being built while we were in negotiations to get permission to have a bank.

Q. What are the criteria for selecting where a habitat bank is going to be? Is it in a green area?

A. We have about nine criteria, one criteria is need. We looked at the shoreline habitat classification and in the upper reaches, red areas were in lowest supply so that is where we concentrate on developing habitat. The second criteria is developing marshes or aquatic habitat from upland. There are some potential possibilities in some of the parks, where we could create channels through the parks, which would actually be creating habitat. The Harbour Commission has a small piece of property by the Knight Street Bridge and we are trying to get them to create a marsh. The other thing is we will be able to create habitat by using marsh benches in red or green areas.

Q. Wherever you create marsh you are destroying another habitat.

A. For instance at Mitchell Island, the new marsh area was largely covered by deep water. Certainly it was habitat, but the habitat we are getting in terms of fish rearing is ultimately better.

Q. Will creating a habitat bank change the coding in these areas?

A. The habitat bank will be red. We will have to prove it is a viable habitat, is physically stable and is biologically growing. Right now the criteria for success is to have the plants established. Then we can see if it is as productive. But until we know that, what do we do? Development is happening all over the place. If this works, we get a net gain.

Q. So some areas which are not red now could become red?

A. Ideally, yes.

Q. Regarding the Hazardous Material Audit, is that going to cover sources from the River or adjacent to the River or are you going to be looking at any industrial sources of discharge?

A. Right now, I think, we are looking more right along the River, with spills and that kind of thing in mind. Ultimately our area will have to expand, depending on how far we want to go. Because the G.I.S. system is not operative yet, we haven't gotten past the initial stages.

Q. What is the G.I.S.?

A. The Geographic Information System. The Province uses it, and the GVRD.

3.0 WORKSHOP ATTENDEES

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